invention and using a control circuit according to the present invention can also be used to achieve temperature stability performance over 0 °C to 70 °C for MSA applications, or a higher temperature for special application.

Equivalents

[0087] While the invention has been particularly shown and described with reference to specific preferred embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined herein. For example, an EAM according to the present invention can be used with any type of laser and is not limited to the use with a DFB semiconductor laser diode.

[0088] What is claimed is:

1. An electro-absorption modulator comprising a semiconductor layer having an electrically controllable absorption, a material composition of the semiconductor layer being chosen so that the semiconductor layer is substantially transparent to light propagating though the semiconductor layer when a substantially zero or a reverse bias voltage is applied across the semiconductor layer at operating temperatures of the electro-absorption modulator that are substantially greater than 25 degrees Celsius.

2. The electro-absorption modulator of claim 1 wherein the semiconductor layer comprises a multi-quantum well layer.

3. The electro-absorption modulator of claim 1 wherein the semiconductor layer comprises a bulk semiconductor layer.

4. The electro-absorption modulator of claim 1 wherein a wavelength of the light propagating though the semiconductor layer is substantially 1310nm.

5. The electro-absorption modulator of claim 1 wherein a wavelength of the light propagating though the semiconductor layer is substantially 1550nm.

6. The electro-absorption modulator of claim 1 wherein the material composition of the semiconductor layer is chosen so that the semiconductor layer is substantially transparent to light propagating though the semiconductor layer when a substantially zero or a reverse bias voltage is applied across the semiconductor layer at operating temperatures of the electro-absorption modulator that are substantially greater than 35 degrees Celsius.

7. The electro-absorption modulator of claim 1 wherein the material composition of the semiconductor layer is chosen so that the semiconductor layer is substantially transparent to light propagating though the semiconductor layer when a substantially zero or a reverse bias voltage is applied across the semiconductor layer at operating temperatures of the electro-absorption modulator that are

substantially greater than 45 degrees Celsius.

8. The electro-absorption modulator of claim 1 wherein the material composition of the semiconductor layer is chosen so that the semiconductor layer is substantially transparent to light propagating though the semiconductor layer when a substantially zero or a reverse bias voltage is applied across the semiconductor layer at a maximum operating temperature of one of the electro-absorption modulator or a laser that generates the light.

9. The electro-absorption modulator of claim 1 further comprising an electronic data modulator having an output that is electrically coupled to a modulation input of the electro-absorption modulator, the electronic data modulator generating an electrical AC modulation signal having a peak-to-peak voltage amplitude that changes an absorption edge of the semiconductor layer, thereby changing light transmission characteristics of the electro-absorption modulator.

10. The electro-absorption modulator of claim 9 further comprising a thermal sensor that is in thermal communication with at least one of the semiconductor layer of the electro-absorption modulator and a laser that generates the light.

11. The electro-absorption modulator of claim 10 further comprising a temperature-driven controller having an input that is electrically coupled to the thermal sensor and an output that is electrically coupled to a DC bias voltage control input of the electronic data modulator, the temperature-driven controller generating a signal that causes the electronic data modulator to change a DC bias voltage of the electrical AC modulation signal.

12. The electro-absorption modulator of claim 11 wherein the temperature-driven controller includes a processor that uses a look-up table to determine the DC bias voltage.

13. An electro-absorption modulated laser comprising:

a) a laser that generates light at an output; and

b) an electro-absorption modulator comprising a semiconductor layer that is optically coupled to the output of the laser, the semiconductor layer having an electrically controllable absorption, a material composition of the semiconductor layer being chosen so that the semiconductor layer is substantially transparent to light propagating though the semiconductor layer when a substantially zero or a reverse bias voltage is applied across the semiconductor layer at operating temperatures of the electro-absorption modulator that are substantially greater than 25 degrees Celsius.

14. The electro-absorption modulated laser of claim 13 wherein the semiconductor layer of the electro-absorption modulation comprises a multi-quantum well layer.

15. The electro-absorption modulated laser of claim 13 wherein the laser comprises a distributed feedback semiconductor laser.

16. The electro-absorption modulated laser of claim 13 wherein the laser and the electro-absorption modulator are integrated onto a single substrate.

17. The electro-absorption modulated laser of claim 13 wherein the laser and the electro-absorption modulator are physically separate devices that are optically coupled.

18. The electro-absorption modulated laser of claim 13 further comprising a thermoelectric cooler that is in thermal communication with the laser.

19. The electro-absorption modulated laser of claim 18 wherein the thermoelectric cooler adjusts the temperature of the laser to change a wavelength of the light generated by the laser.

20. The electro-absorption modulated laser of claim 13 wherein a wavelength of the light generated by the laser is substantially 1310nm.

21. The electro-absorption modulated laser of claim 13 wherein a wavelength of the light generated by the laser is substantially 1550nm.

22. The electro-absorption modulated laser of claim 13 wherein a voltage sensitivity with respect to wavelength of the electro-absorption modulator is substantially the same as a voltage sensitivity with respect to wavelength of the laser.

23. The electro-absorption modulated laser of claim 13 wherein the material composition of the semiconductor layer of the electro-absorption modulator is chosen so that the semiconductor layer is substantially transparent to light propagating though the semiconductor layer when a substantially zero or a reverse bias voltage is applied across the semiconductor layer at operating temperatures of the electro-absorption modulator that are substantially greater than 35 degrees Celsius.

24. A transmitter for an optical communication system, the transmitter comprising:

a) a laser that generates light at an output;

b) an electro-absorption modulator having an electrically controllable absorption, the electro-absorption modulator comprising a semiconductor layer that is optically coupled to the output of the laser, a material composition of the semiconductor layer being chosen so that the semiconductor layer is substantially transparent to light propagating though the semiconductor layer when a substantially zero or a reverse bias voltage is applied across the semiconductor layer at operating temperatures of the electro-absorption modulator that are substantially greater than 25 degrees Celsius;

c) an electronic data modulator having an output that is electrically coupled to a modulation input of the electro-absorption modulator, the electronic data modulator generating an AC electrical modulation signal having a peak-to-peak voltage amplitude that changes an absorption edge of the semiconductor layer, thereby changing light transmission characteristics of the electro-absorption modulator and modulating the light generated by the laser;

d) a thermal sensor that is in thermal communication with at least one of the semiconductor layers of the electro-absorption modulator and the laser; and

e) a temperature-driven controller having an input that is electrically coupled to the thermal sensor and an output that is electrically coupled to a DC bias control input of the electronic data modulator, the temperature-driven controller generating a signal that causes the electronic data modulator to change a DC bias voltage of the electrical AC modulation signal.

25. The transmitter of claim 24 wherein a wavelength of the light generated by the laser is substantially 1310nm.

26. The transmitter of claim 24 wherein a wavelength of the light generated by the laser is substantially 1550nm wavelength.

27. The transmitter of claim 24 wherein a voltage sensitivity with respect to wavelength of the electro-absorption modulator is substantially the same as a voltage sensitivity with respect to wavelength of the laser.

28. The transmitter of claim 24 wherein the material composition of the semiconductor layer of the electro-absorption modulator is chosen so that the semiconductor layer is substantially transparent to light propagating though the semiconductor layer when a substantially zero or a reverse bias voltage is applied across the semiconductor layer at operating temperatures of the electro-absorption modulator that are substantially greater than 45 degrees Celsius.

29. A method of generating data modulated light, the method comprising:

a) generating light;

b) propagating the light through a semiconductor layer having an electrically controllable absorption, a material composition of the semiconductor layer being chosen so that the semiconductor layer is substantially transparent to light propagating though the semiconductor layer when a substantially

zero or a reverse bias voltage is applied across the semiconductor layer at operating temperatures of the electro-absorption modulator that are substantially greater than 25 degrees Celsius;

c) elevating the temperature of the semiconductor layer above 25 degrees Celsius;

d) applying a DC reverse bias voltage across the semiconductor layer; and

e) applying an AC electrical modulation signal having a peak-to-peak voltage amplitude across the semiconductor layer, the modulation signal changing an absorption edge of the semiconductor layer, thereby modulating the light.

30. The method of claim 29 further comprising:

a) measuring a temperature of at least one of the semiconductor layers and a laser that generates the light; and

b) changing the DC reverse bias voltage across the semiconductor layer in response to the measured temperature.

31. The method of claim 29 further comprising:

a) measuring a temperature of at least one of the semiconductor layers and a laser that generates the light; and

b) changing a bias current driving a laser that generates the light in response to the measured temperature.

32. A method of tracking a temperature of an electro-absorption modulator to a temperature of a semiconductor laser, the method comprising:

a) generating light with a semiconductor laser;

b) propagating the light through an electro-absorption modulator comprising

a semiconductor layer having an electrically controllable absorption, a material composition of the semiconductor layer being chosen so that the semiconductor layer is substantially transparent to light propagating though the semiconductor layer when a substantially zero or a reverse bias voltage is applied across the semiconductor layer at operating temperatures of the electro-absorption modulator that are substantially greater than 25 degrees Celsius;

c) applying an AC modulation signal having a DC reverse bias voltage and a peak-to-peak voltage amplitude across the semiconductor layer, the modulation signal changing an absorption edge of the semiconductor layer, thereby changing light transmission characteristics of the electro-absorption modulator and modulating the light generated by the laser;

d) measuring a temperature of the semiconductor laser that generates the light; and

e) changing at least one of the DC reverse bias voltage and the peak-to-peak voltage amplitude of the electrical modulation signal, and a bias current through the laser in response to the measured temperature.